

## CHAPTER 3

# GEOPHYSICAL EXPLORATION

This chapter includes the following information:

- NPS permitting process checklist for geophysical operations,
- Plan of operations information requirements for geophysical operations,
- Required operating stipulations,
- Recommended mitigation measures, and
- Pictorial overview of geophysical operations.

### NPS PERMITTING PROCESS CHECKLIST FOR GEOPHYSICAL EXPLORATION

The following checklist outlines the permitting process for geophysical operations in units of the NPS. The items on the checklist are described throughout this handbook. This checklist can be used by an oil and gas operator to make sure that all of the required steps have been completed to prepare and have a plan of operations approved by the National Park Service.

- ☐ Operator contacts park regarding interest in conducting oil and gas operations (for more information see CH 2).
- ☐ Operator provides written documentation demonstrating right to conduct operations (for more information see CH 2).
- ☐ Operator meets with park staff to scope proposed project (for more information see CH 2).
- ☐ Operator meets with affected federal, state, and local agencies to identify resource issues, permitting requirements, and impact mitigation strategies (for more information see CH 2).
- ☐ Operator requests temporary access permit to gather information needed to complete the plan of operations (for more information see CH 2).
- ☐ Operator conducts necessary surveys, including natural and cultural surveys, as applicable and surveys / stakes the operations area (for more information see CH 2).
- ☐ Operator prepares plan of operations and submits draft plan to the National Park Service (for more information see CH 3).

The Plan of Operations for Geophysical Exploration must include the following sections:

- ☐ I. Lease and Ownership Information
- ☐ II. Maps and Plats
- ☐ III. Timeline for Operations
- ☐ IV. Description of Operations
- ☐ V. Spill Control Plan
- ☐ VI. Reclamation Plan
- ☐ VII. Affidavits and Statements
- ☐ VIII. Other Applicable Permits
- ☐ IX. Background Environmental Information
- ☐ X. Relationship to Park Planning Documents

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- ☐ NPS performs a completeness and technical review of the plan of operations (for more information see CH 2).
- ☐ Operator revises plan of operations, if necessary (for more information see CH 2).
- ☐ Park staff prepares NEPA document (or adopts operator's or consultant prepared NEPA document), incorporates other environmental compliance, and initiates mandated consultations with other agencies (for more information see CH 2).
- ☐ Park completes public review process, finalizes decision documents, and notifies the operator that the plan has been approved, conditionally approved, or rejected (for more information see CH 2).
- ☐ Operator agrees to conditions of approval (if any), submits applicable state and federal permits, and files performance bond with the NPS (for more information see CH 10).

## PLAN OF OPERATIONS INFORMATION REQUIREMENTS

This list of requirements is presented to assist National Park Service personnel and nonfederal oil and gas operators in defining specific information that should be included in a proposed plan of operations for geophysical operations. These requirements are based on the regulatory provisions under 36 CFR §9.36. This information list can also be used by the NPS to determine if a proposed plan of operations is complete and sufficiently detailed to merit "official acceptance" for review and analysis in accordance with the regulations at 36 CFR §9.36(c).

A plan of operations may not need to address all of the information requirements presented in this list. The operator and NPS staff will narrow the list during project scoping. In some instances, the NPS may require additional information not specifically listed here so that it may effectively analyze the proposed operation. Such additional information also would be identified during project scoping.

The operator will submit the plan of operations, tender the performance bond, and be the responsible party for compliance with the plan of operations.

### I. LEASE AND OWNERSHIP INFORMATION

The purpose of this section is to identify the "operator" as defined under the NPS regulations, to document the operator's right to conduct oil and gas activities under the rights associated with the mineral estate, and to identify primary company contacts for planning, field operations, and emergencies.

- A. Name(s) and address(es) of:
  - 1. Surface owner(s) (if other than the NPS), and
  - 2. Lessor (mineral owner).
- B. Name, address, and telephone number of the operator including:
  - 1. Person accountable for operations,
  - 2. Field representative, and
  - 3. Contact person in case of spill, emergency, etc.
- C. Copy of the instrument(s) demonstrating the operator's right to conduct geophysical operations for all tracts of land within the project area. Examples include:
  - 1. Deed or affidavit of mineral ownership,
  - 2. Lease documents, or
  - 3. Written consent of mineral right holder(s) for the operator to obtain geophysical data.

### II. MAPS AND PLATS

The purpose of this section is to graphically show the operator's mineral tracts and the area of proposed activities in relation to the park, and the locations of man-made or environmental hazards that may affect the methods of operations.

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- A. Provide map(s) showing the proposed seismic survey area. The map(s) should be on the appropriate 1:24,000 scale USGS quadrangle(s) (7.5 minute series) and identify the following:
1. NPS park unit boundary,
  2. Each mineral tract or lease cross referenced to the “right to operate” information provided in Section I. C.,
  3. Proposed locations of source and receiver lines within the park,
  4. Locations of pipelines, wells, or any other potential hazards within a one-mile radius of the proposed survey lines, and
  5. Locations of environmentally sensitive areas that might require avoidance or other mitigation measures.

### **III. TIMELINE FOR OPERATIONS**

The purpose of this section is to identify when operations will be conducted and how long they will last. Any proposals to avoid or modify operations due to season timing restrictions should also be noted in this section.

- A. Provide an estimated timeline for the proposed operation, including the following information (as applicable):
1. Estimated date to begin equipment transportation to the staging area,
  2. Estimated date to begin geophysical operations,
  3. Estimated geographic sequence of operations for the 3D seismic survey,
  4. Anticipated longevity of operations,
  5. Estimated date when reclamation will begin, and
  6. Estimated time to complete reclamation.

### **IV. DESCRIPTION OF OPERATIONS**

The description of operations should provide enough detail on the proposed methods, sequence, and equipment to assess the proposal's affects on the environment. Thus the amount of information in this section will vary depending both on the planned activities and the environment where they will be conducted. Address the following requirements as applicable, providing enough detail for the NPS to have a clear understanding of the proposal.

- A. Methods, sequence of work, and all equipment to be used in acquiring seismic data (include photographs of equipment):
1. Vehicle description and use,
  2. Source point locations and line layout,
  3. Receiver lines configuration, and
  4. Energy sources (e.g. explosives, vibroseis trucks, etc.).

NOTE: Operators cannot use sources of water inside the park without written permission of the Regional Director. The Regional Director can only approve a plan of operations that uses a source of water from inside the park if one of two conditions exist: 1) the operator owns a superior water right, or 2) use of the water does not damage park resources (36 CFR §9.35).

- B. Description of all actions to control, minimize, or prevent damage to the recreational, biological, scientific, cultural, and scenic resources of the park. These include those measures (place, time, methods, equipment) that the operator and NPS identified during scoping and the onsite meeting to improve operations with respect to park resources and visitor safety (as well as any other measure developed by the operator during their plan preparation). This also includes all actions to be taken to comply with regulatory operating standards and state and federal permit requirements (as applicable). See Tables 3.1 and 3.2 for lists of operating stipulations and recommended mitigation measures for geophysical operations.
- C. Description of all security measures that will be used to ensure public health and safety.
- D. Statement that operator will comply with operating standards of 36 CFR §9.41-9.46. Requests for variances should be accompanied with supporting information.

## **V. SPILL CONTROL PLAN**

The requirements for a Contaminating or Toxic Substance Spill Control Plan (Spill Control Plan) are not specifically found in the 9B regulations. The NPS has combined informational requirements and operating standards from the 9B regulations to develop a format for a Spill Control Plan. See *Chapter 11 – Spill Control Plan* for the organization and content of a Spill Control Plan.

## **VI. RECLAMATION PLAN**

The reclamation plan will describe the actions needed to meet the general regulatory reclamation standards<sup>1</sup> as well as site-specific reclamation goals. The procedures of the reclamation plan then will be based on the disturbance anticipated from the proposed operations (as described in Section IV.), and reclamation expectations of the NPS as identified during project scoping. The operator should organize the reclamation plan with the following sections.

### **A. Reclamation Goals.**

1. Summarize the site-specific reclamation goals developed during project scoping. Site-specific goals might include a desired percent of vegetative ground cover, the type of plants, soil stabilization, rutting repair, etc.
2. State the timeframes for reclamation. Describe when the reclamation activities would begin, how long they would last, and the schedule for monitoring the results of the reclamation.

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<sup>1</sup> See §9.39, Reclamation Requirements, and Chapter 7, Surface Reclamation of this Handbook, pp. 7-22 through 7-23.

### **B. Reclamation Procedures.**

The regulations provide steps that need to be completed at a minimum to satisfy reclamation standards for operations on federal surface.<sup>2</sup> The following steps have been adjusted to fit the impacts from seismic operations that commonly need active reclamation. They may be used as an outline for developing the plan's reclamation procedures. The operator can describe the methods and equipment that will be used to accomplish each of these steps.

1. Restore areas of disturbance around shotholes including natural contours and vegetative state. (Note: The method(s) of plugging shotholes should be covered in the description of operations section of the plan.)
2. Remove all equipment, stakes and flagging, and all other man-made debris that resulted from operations.
3. Restore trails created or altered by vehicles to their natural contours and vegetative state.
4. Monitor and report on the results of the reclamation effort.
5. Remove or neutralize contaminating substances. The operator is responsible for removing soils or any other material that becomes contaminated. If there is reason to suspect soils or groundwater have been contaminated, the operator will likely need to collect and test samples to verify that contaminating substances have been removed or neutralized. Neutralization or removal of contamination means that contaminant concentrations will be reduced in soils (or groundwater) to a condition that will not adversely affect, injure, or damage federally-owned or controlled lands and waters, provides for the safe movement of native wildlife, and which does not jeopardize visitor health and safety.

### **C. Reclamation Cost Estimate.**

The cost of reclamation in part determines the amount of the performance bond.<sup>3</sup> Provide an estimate of costs for a third party to complete the reclamation procedures in Item B above. Provide enough detail to support the total estimate.

The NPS will verify and use the cost estimates to set the reclamation portion of the performance bond. If the operator chooses not to provide the cost estimate for reclamation, the performance bond may be set at the maximum amount allowed by regulation<sup>4</sup>, which is \$200,000 per operator per park unit. If the operator already holds a \$200,000 bond for other operations in the same park, it is unnecessary for the operator to provide the cost estimate information required by this section.

## **VII. AFFIDAVITS AND STATEMENTS**

- A. Include an "Affidavit of Compliance" signed by an authorized official of the company as required by regulations at 36 CFR §9.36(a)(15). The affidavit should state that the proposed operations are in compliance with all applicable federal, state and local laws and regulations.

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<sup>2</sup> For operations on private surface estate, see page 7-18 of this Handbook

<sup>3</sup> See §9.48(d)(1) and page 10-3 of this Handbook

<sup>4</sup> See §9.48(d)(3) and page 10-3 of this Handbook

- B. Include a statement that the operator is fully accountable for all contractor and subcontractor compliance with the requirements of the approved plan of operations. This statement serves to clarify the operator's responsibility under the regulations at 36 CFR §9.41(g).
- C. Include a statement that the park superintendent, or his/her representative, shall have reasonable access to the site as is necessary to monitor and ensure compliance with the approved plan of operations. This statement serves to meet the regulatory requirement at 36 CFR §9.37(f).

## **VIII. OTHER APPLICABLE PERMITS**

- A. Include a copy of, or application for, all other permits required by other federal, state, or local agencies.

## **IX. BACKGROUND ENVIRONMENTAL INFORMATION**

The purpose of this section is to; present information on existing natural and cultural resources in the project area, assess the environmental impacts of the proposed operation, and discuss any technologically feasible alternatives for the proposed operation. Information that should be presented in this section will be determined during project scoping with park staff. The park may have some of the required natural and cultural resource information for the operator's use in preparing this section of the plan.

- A. Description of natural resources in the proposed operation area as they relate to the design and implementation of the seismic survey.
  - 1. Generalized description of the surface and subsurface geology for the area of operations. Include the following in the discussion:
    - a. surface formation(s) and thickness,
    - b. generalized description of the subsurface geology, including stratigraphy and depths to formation tops,
    - c. proposed total depth of penetration of seismic waves and depth of potential (or known) producing formations,
    - d. soil type(s) and engineering properties such as permeability, porosity, erosion potential, etc., and
    - e. description of paleontological resources known to occur or likely to occur in the project area (if applicable). The discussion should include the results of paleontological survey of the project area performed by a qualified paleontologist approved by the NPS.
  - 2. Hydrology and water quality, including the following:
    - a. proximity to surface water (intermittent or permanent watercourses, streams, ponds, lakes, springs, etc.),
    - b. depth to groundwater,
    - c. proximity to the base floodplain, 100 year floodplain, and 500 year floodplain, and
    - d. water quality in nearby surface water and/or shallow groundwater.
  - 3. Vegetation species composition in operation area, including predominant herbaceous, shrub, midstory and overstory species. (Note: This information is necessary to properly design a reclamation plan).

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4. Wildlife species composition in the proposed operation area.
  5. Federal or state threatened / endangered plant or wildlife species that inhabit or frequent the proposed operation area.
  6. Air quality in the proposed operation area, including information on pollutant levels and existing point sources for pollutants in the area.
  7. General description of baseline noise levels in the proposed operation area, including local sources contributing to increased noise levels.
- B. Description of cultural resources in the proposed operation area (if new surface disturbance is proposed) should include the following information:
1. Background information on archeological and historic resources documented in the general area, including review of the National Register of Historic Places, and
  2. Results of an archeological and historic resource field survey of project area performed by a professional archeologist approved by the NPS.
- C. Identification and proximity of park visitor use areas (e.g., trails, campgrounds, public roads, picnic areas, overlooks etc.) from the proposed operation area,
- D. Description of the anticipated direct, indirect, and cumulative effects of the proposed operation on the park natural and cultural resources, and socioeconomic environments listed above. (This is the operator's opportunity to support their conclusions on environmental effects of their operations.)

## **X. RELATIONSHIP TO PARK PLANNING DOCUMENTS**

- A. The plan of operations must discuss how the proposed operation relates to park planning documents (General Management Plan, Oil and Gas Management Plan, etc.) in terms of considering and integrating operational measures described in the plan(s) to achieve park management objectives. The park oil and gas contact will furnish a copy of all applicable park planning documents upon request.



## REQUIRED OPERATING STIPULATIONS AND RECOMMENDED MITIGATION MEASURES FOR GEOPHYSICAL EXPLORATION

The tables in the following section describe required operating stipulations (Table 3.1) and recommended mitigation measures (Table 3.2) for geophysical exploration on NPS lands. The primary resource(s) that would be protected by the operating stipulations and mitigation measures listed in the tables are denoted by a ✓ symbol. Other resources that would benefit from the protective measures are marked with a + symbol.

Table 3.1 focuses on the National Park Service's Nonfederal Oil and Gas regulations at 36 CFR Part 9 Subpart B. but also includes many applicable operating stipulations required under other federal laws and regulations. To ensure compliance with all applicable legal and policy mandates, it is the operator's responsibility to consult with the appropriate federal, state, and local agencies prior to conducting operations on NPS lands.

**Table 3.1. Required operating stipulations for geophysical exploration operations on National Park Service lands**

Geophysical Exploration  Required Operating Stipulations   The applicable legal citation is noted in [parenthesis] after the stipulation.	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience
Surface operations shall at no time be conducted within 500 feet of the banks of perennial, intermittent or ephemeral watercourses; or within 500 feet of the high pool shoreline of any natural or man-made impoundments...unless specifically authorized by an approved plan of operations. If necessary, the operator must specifically request exemptions from this standard in the plan of operations and demonstrate that the exemptions are necessary for acceptable data quality, can be conducted with insignificant affects on park waters or manmade infrastructure, and result in overall resource impact reduction [36 CFR §9.41(a)].		+		✓	✓	+	✓	+	+		+
Discharge explosives at safe distances from pipelines, telephone lines, railroad tracks, roads, power lines, water wells, oil and gas wells, oil and gas production facilities, buildings, etc. Use accepted industry minimum safe offset distances, unless otherwise specified [36 CFR §9.37(a)(1)].											✓
Protect all survey monuments, witness corners, reference monuments and bearing trees against destruction, obliteration, or damage from operations. Operator shall be responsible for the reestablishment, restoration, or referencing of any monuments, corners, or bearing trees which are destroyed, obliterated, or damaged by such operations [36 CFR §9.41(b)].						✓				+	

<b>Geophysical Exploration</b>  <b>Required Operating Stipulations</b>  The applicable legal citation is noted in [parenthesis] after the stipulation.	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience
The operator shall take technologically feasible precautions to prevent accidents and fires [36 CFR §9.46].	+	+	+	+	+	+	+	+	+	+	+
Operators shall not injure, alter, destroy, or collect any object, structure, or site of historical, archeological, or cultural value, without written authorization from the NPS [36 CFR §9.47(a); 43 CFR §3].			✓							✓	+
A qualified monitor must be present during appropriate operational phase(s). Once operations have commenced, the operator shall immediately bring to the attention of the superintendent any cultural or scientific resource encountered that might be altered or destroyed by the operation and shall leave such discovery intact until told to proceed by the superintendent. The superintendent will evaluate the discoveries brought to his/her attention, and will determine within ten (10) days what action will be taken with respect to such discoveries [36 CFR §9.47(b)].			✓							✓	+
Use of park roads must be in accordance with procedures outlined in an approved plan of operations [36 CFR 9.50].		✓		+				+	+		✓
Include stop work provisions in the event of a cultural or scientific discovery in operator's the contracts [36 CFR §9.47(b); 36 CFR§800.11].			✓							✓	+
Do not locate staging areas within the 100-year floodplain. If there is no practicable alternative to siting in the floodplain, floodproof structures [EO 11988 Sec 3 (b)].		+		+	✓	+	+	+	+		✓

**Table 3.2. Recommended mitigation measures for geophysical exploration on National Park Service lands**

Geophysical Exploration  Recommended Mitigation Measures	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience Human Health and Safety
Minimize conflicts with visitors by avoiding designated visitor use areas. If operations are needed in or around designated visitor use areas for successful completion of the project, then schedule work during low visitor use times and/or implement strategies to minimize the sights, sounds, and duration of operations in and around designated visitor use areas.										✓	✓
Use minimum number of vehicles, boats, or aircraft necessary to provide efficient and safe access for personnel and equipment.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Reduce vehicle speed to minimize dust.	✓			+		+		+			+
Consider spraying designated roads and access routes with fresh water (or other environmentally safe substance) to reduce dust.	✓			✓		✓					
Use properly designed, maintained and operated equipment to reduce emissions such as proper engine fuel mixtures, regularly serviced exhaust systems, and proper engine tuning.	✓									+	
Use designated access routes, designated roads, and natural routes (e.g., waterways) whenever possible during operations and during travel to and from the project area.		✓	+	✓	+	+	+	+	+	+	✓
Locate primary staging areas outside of the park. Confine refueling, lubrication, and maintenance of vehicles and equipment to areas outside the park where feasible.		✓		✓	+	+	+	+	+	+	+
Where feasible, use global positioning systems (GPS) technology to minimize the amount of vegetation removal when surveying source and receiver lines.		+		+	+	✓	+	+	+	+	
Conduct operations during dormant (plant dormancy) seasons.						✓	+				
Cut vegetation by hand, supplementing as necessary with chain saws or other motorized cutting equipment.										✓	✓

<b>Geophysical Exploration</b>  <b>Recommended Mitigation Measures</b>	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience
Selectively cut vegetation along source and receiver lines, offsets, and designated access routes as necessary to accommodate safe passage of personnel and equipment.		+		+		✓		+	+		✓
Leave small vegetation in place, (low shrubs, and herbaceous vegetation) consistent with safe passage of personnel and equipment.		+		+	+	✓	+	✓	+		✓
Leave topsoil, rootstock, and seeds on lines and designated access routes to encourage natural revegetation.		✓		+	+	✓	+	+	+		
Clear vegetation in accordance with the park's current vegetation management plans or policies.		+		+	+	✓	+	+	+		✓
Secure flagging, other markers, cables, or other equipment without cutting or slicing vegetation.						✓					✓
Do not permanently mark any tree in the park.											✓
Use means of access other than land vehicles when soils are saturated to minimize compaction, displacement, and rutting of clayey soils.		✓	+	+	+	+	+				
Conduct operations during dry seasons when soils are less susceptible to compaction, displacement and rutting.		✓	✓	+	+	+	+				
Use vehicles with low ground pressure to minimize surface impacts.		✓		+	+	+	+				+
Plan efficient refueling of vehicles and equipment to minimize travel and chances for spills.		✓		✓	+	+	+	+	+		+
Refuel or lubricate equipment over secondary containment such as drip pans, drip basins, or impenetrable polyvinyl covered by absorbent materials.		✓		✓	+	+	+	+	+		+

Geophysical Exploration  Recommended Mitigation Measures	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience
Periodically check for leaks under all operating vehicles and equipment; contain and remove contaminated soil for proper disposal.		✓		✓	+	+	+	+	+		+
Replace all cuttings in shotholes / boreholes, including proper tamping of cuttings during shothole plugging. Avoid backfilling shotholes too quickly to avoid bridging. Spread any remaining cuttings on the surface into a thin layer at each hole. Note: Plugging materials may be required for shotholes less than 20 feet deep.		✓									✓
Use existing stream crossings whenever practical.				✓	+	+	+	+	+		+
Minimize stream crossings, if necessary to conduct operations, cross at right angles to the stream.		+		✓	+	+	+	+	+		
Ensure that approaches to stream crossings do not alter natural drainage into the stream. Temporary runoff diversion and/or erosion control structures may be appropriate to minimize erosion and vegetation loss.		+		✓	+	✓	+	+	+		
Whenever practical, cross streams or watercourses where the water is shallow and the streambed or bottom is firm.		+		✓		+	+	✓	✓		
Minimize width of survey lines and designated access routes, particularly at water crossings to minimize input of sediment and vegetation in watercourses.		+		✓	+	+	+	+	+		
Avoid blocking or filling any natural drainage path.				✓	+	+	+	+	+		
When traveling in water, slow vehicle and boat speeds to minimize resource damage.				✓	+	✓	+	✓	✓		+
When using boats, ensure adequate water depth to minimize bank erosion and effects on aquatic life.		✓		+	+	✓	+	✓	✓		
Secure portable fuel tanks to the boat for safety and to prevent loss.				✓		+	+	+	+		✓

<b>Geophysical Exploration</b>  <b>Recommended Mitigation Measures</b>	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience
Use loading poles or tamping poles to ensure charges are placed and seated at the proper depth, and shotholes are properly plugged with cuttings and/or other authorized materials. Use plugging materials that meet International Association of Geophysical Contractors (IAGC) standards.	✓		+	✓							✓
Use plugging materials in tubes or casing which will expand appropriately. Recommended tube diameter is 75 percent of shot-hole diameter.	✓			✓							
Plugs should set at least 24 hours before detonation of charges.	✓			✓							
If a flowing shothole occurs (groundwater under artesian conditions), attempt to plug it immediately. If the flow is too great, use expansive plugging material inflatable plug above the aquifer and backfill with expansive plugging material to the surface.	✓			✓							+
Clean vehicles and equipment prior to entering the project area to avoid introducing foreign plant materials.						✓					+
For vehicles, clear the undercarriage of brush to prevent fires when driving over dry areas. Use spark arresters and spark suppression accessories on equipment.					+	✓	+	+	+		+
Avoid threatened, endangered and sensitive species and their habitats during project design.						✓			✓		
Use US Fish and Wildlife Service "Conservation Guidance for Plant and Animal Candidate Species" to plan and conduct operations that will minimize disturbances to these species.						✓			✓		
Provide field personnel with training in identification and habits of wildlife in the project area.								✓	✓		
If using helicopters, locate helipads as far apart as practical in existing clearings.								✓	✓		✓

<b>Geophysical Exploration</b>  <b>Recommended Mitigation Measures</b>	RESOURCE PROTECTED										
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience
Consistent with safety, minimize the number of helicopter flyways.								✓	✓		✓
Use long sling lines, consistent with safety, to minimize the effects of down draft from the rotor.								✓	✓		✓
Avoid or bypass wildlife areas marked on the project map and/or in the field to minimize disruption to wildlife, especially in areas of active denning, nesting, spawning, migration, and feeding. Where interaction with wildlife is unavoidable, minimize the sights, sounds, and duration of operations to the maximum extent feasible.								✓	✓		+
Use qualified monitors with expertise in identifying threatened, endangered and sensitive plant and wildlife species and their habitats to accompany field crews, especially land survey crews.						✓		✓	✓		
Report any sighting of threatened, endangered, or sensitive species or paleontological resources to the NPS.			✓			✓			✓		
Inform visitors and area residents and users while planning and conducting an operation. For example, post warning and informational signs, notices in visitor centers, notices in local newspapers and publications, etc.											✓
Adequately sign project area, especially at visible intersections and locations, indicating type of operation and other information and appropriate actions.											✓
Immediately following completion of operations, remove survey stakes, flagging, trash, and other debris or waste from the project area.											✓
Do not burn vegetation, survey stakes, flagging, refuse, or other debris or waste incidental to maintenance or operation.	✓					+					✓
Provide trash bags and trash receptacles for cans, bottles, paper, and other trash generated daily by crews.											✓

<b>Geophysical Exploration</b>  <b>Recommended Mitigation Measures</b>	RESOURCE PROTECTED											
	Air Quality	Soils	Paleontological Resources	Water (Surface and G.W.)	Floodplains	Vegetation	Wetlands	Fish and Wildlife	T & E Species	Cultural Resources	Visitor Use and Experience	Human Health and Safety
Hold daily safety and environmental meetings with crews to reinforce crew and public safety, environmental concerns, and operating procedures.	+	+	+	+	+	+	+	+	+	+	+	✓
Bury and/or secure capwire from undetonated or live charges to reduce risk to human health and safety.												✓
Take appropriate measures to ensure all charges are fired. Disable misfired charges by breaking or cutting the capwire as deep below ground as practical.												✓
When working in dry vegetation, prohibit smoking, or only allow smoking at designated times and locations.						✓						✓
Ensure fire-fighting equipment and personnel are available while operating in dry vegetation. Consider both fire danger and fire danger rating during planning and conduct of operations.	+					✓						✓
Use seed, mulch, or other authorized materials or structures to mitigate the potential for erosion.		✓	✓	✓	+	+	+	+	+		+	



## GEOPHYSICAL OPERATIONS - A PICTORIAL OVERVIEW

Geophysical operations are of relatively short duration and can usually be planned and executed in a way that surface impacts will be temporary. Crews may be in the field for 1 to 4 weeks for a conventional single line survey, and an average 3-dimensional survey may take several months to complete. The intensity of surface impacts will be largely controlled by the methods of access and the equipment used to drill shotholes. The following resource issues are commonly associated with geophysical activities:

- Access along source and receiver lines may require varying levels of vegetation removal.
- Travel along source and receiver lines by overland vehicles may damage soils (compaction or rutting) and vegetation.
- Water quality may be degraded from sedimentation (eroded soils or shothole cuttings)
- Small spills and improperly handled wastes can degrade soils and waters, harm vegetation, fish, and wildlife, air quality, and aesthetics.
- Air quality is degraded from dust and engine emissions.
- The natural sound is interrupted by vehicles and drilling noises.
- Fish and wildlife are injured by human presence, vehicular injury, exposure to contaminants, loss or degradation of habitat, or unauthorized takings.
- Cultural resources may be threatened by direct disturbance, increased human accessibility and fire.
- Large crews that are active in an area may disrupt park visitor uses and experiences.



## STRATEGIES TO MINIMIZE IMPACTS FROM SEISMIC OPERATIONS

- Schedule operations to avoid conflicts with visitors and critical wildlife nesting or mating periods. Seasonal timing of operations may also help minimize impacts on soils, water, and vegetation.
- When siting and accessing seismic lines, use existing roads and trails to the maximum extent feasible.
- Position survey lines and access routes to minimize the number and size of stream crossings.
- Use global positioning devices instead of line of sight surveying to minimize the amount of vegetative cutting. Hand cut vegetation along seismic lines where a line of sight survey is necessary.
- Use vehicles that will not disturb the soils and vegetative root systems. Seasonal timing may help minimize impacts on vegetation. Foot access and hand portable drills may be feasible in areas where large vehicles would cause noticeable damage to soils and vegetation.
- Use foot access for receiver lines if vehicular access will require active reclamation steps.
- Consider the use of mini-shothole patterns so that smaller, less damaging equipment may be used to drill the shotholes.
- Minimize the number of passes along a line that uses vehicular access. Often single passes are achievable with careful planning.
- In areas where cultural resources are expected, have a qualified archeologist accompany each survey crew to identify and avoid cultural sites.
- Offset shotpoints from structures, water bodies, and sensitive resource areas.



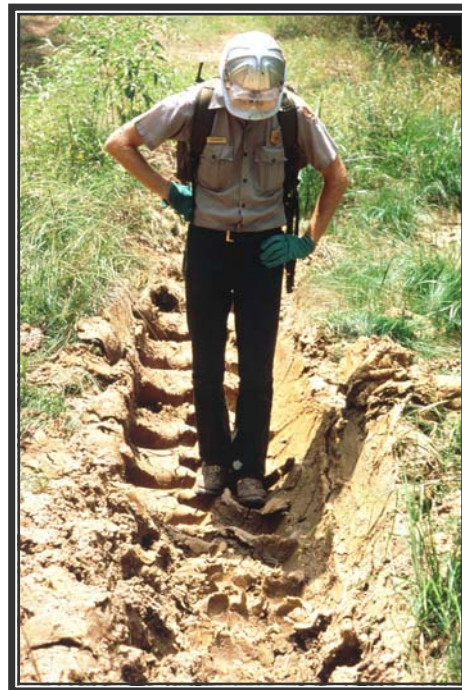
A recording station uses telemetry to transmit geophone data to the recording truck.



**PROPER SELECTION OF SHOTHOLE DRILLING EQUIPMENT**

**Proper selection of shothole drilling equipment is the key to reducing impacts on park resources.**

Shotholes previously drilled to 100-foot depths have given way to mini-shothole patterns. The mini-shothole patterns may consist of 5 to 10 shotholes drilled to depths of 3 to 5 feet. Heavy articulated buggies that are used to drill deep shotholes can destroy small trees, create wide pathways, and leave sizeable ruts. In Big Thicket National Preserve this method of access has resulted in less damage to park resources.

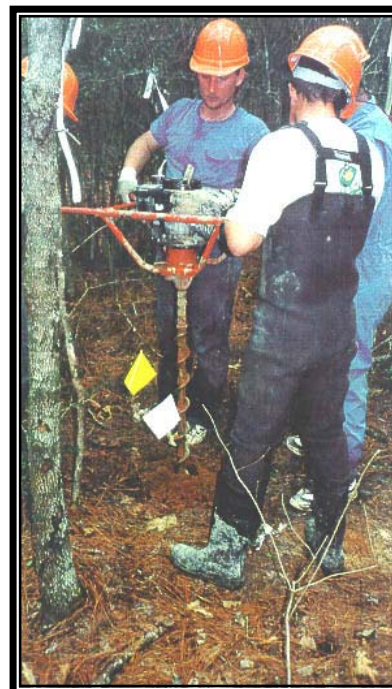






In older surveys, trails were cut to provide access for the large drilling equipment shown at the left.

Use of the hand portable drills to drill the mini-hole patterns minimizes impacts on soil and vegetation.



When the flagging is removed from this mini-hole seismic line (photo taken down the line), it will be difficult to identify the line's location.

## USE OF EXISTING TRAILS AND ONE PASS STRATEGIES

In Big Cypress National Preserve, some areas have a high concentration of existing trails from recreational ATV and swamp buggy use. An operator successfully designed a 3D seismic survey with source lines maximizing the use of existing trails in the survey area. A muskeg carrier fitted with a water tank and drill worked well for drilling shotholes along the existing trails. Surface impacts were minimal and generally required no active reclamation measures.



Proper planning along a seismic line that requires vehicular access is the key to limiting the number of trips the vehicle makes up and down the line. One-pass operations are feasible in many instances. Helicopters have also been used successfully move personnel, equipment, and supplies to minimize the number of vehicle passes.



## USE OF HELICOPTERS

Helicopter transport of drilling equipment precludes the need for new trails in sensitive and difficult to reclaim areas. Surface impacts are limited to the immediate area around each shothole.



In Big Cypress National Preserve the operator staged helicopters from an existing disturbed area, in this case an active production site.



For this job, three heli-portable drilling units kept a single helicopter busy and minimized the time the crew had to wait for equipment.



Four sling loads were used to move the air drilling unit, compressor, power unit, and toolbox from one shotpoint to the next.

## USE OF LOW IMPACT VEHICLES



The wide tracks on this shothole drilling rig distribute the vehicles weight over a large area giving it a very low pound per square inch displacement. Aluminum construction of many typically steel components contributes to the very low displacement of this tracked marsh buggy.

A person might leave footprints two inches deep on this sensitive mudflat environment, but the aluminum buggy did not create any ruts over 1/2 inch deep. Reclamation was restricted to just a few areas.



Conventional vehicles with tires created rutting in this mudflat area over 15 years ago. Restoration to pre-disturbance conditions would be difficult to accomplish in this type of environment.



**Avoid damage to the soil and root structure and eliminate costly reclamation projects.**

Use of vehicles with large “terra-tires” is another method used to distribute a vehicle’s weight, like on this water truck. ATV’s are designed with this principle, and may be appropriate for transporting personnel and equipment along survey lines.



Though the exposed blades of grass are damaged by the vehicle, the root systems and soil structure are not.



Soon after the survey is complete, the grass is growing again without the need for the company to perform any type of active reclamation.